

REMARKS:

IN THE DRAWINGS:

Applicants submit herewith an amended Figure 2B to correct for a typographical error. No new matter is submitted with the drawing amendment. The Applicants respectfully request this rejection be withdrawn.

IN THE SPECIFICATION:

The Examiner objected to several typographical errors in the specification. The Applicants present herewith substitute paragraphs to correct for these and several other typographical errors inadvertently submitted in the original specification. No new matter is added with the substitution of these substitute paragraphs. The Applicants respectfully request this rejection be withdrawn.

IN THE CLAIMS:

In the detailed office action mailed October 6, 2003, the Examiner rejected all the claims in the application. Claims 1-8, 12-14, 17, 25-34, 44, 48-51, 55-56, and 66-67 were rejected under 35 U.S.C. § 102(e) as being anticipated by U.S. Patent No. 6,199,018 to Quist *et al.* (hereinafter "Quist"). Claims 9, 15, 24, 35, 45, 47, 52, 54, and 57 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of U.S. Patent No. 4,766,595 to Gollomp (hereinafter "Gollomp"). Claims 10, 21-23, 36, 41-43, 46, 53, 58, and 63-65 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of U.S. Patent No. 6,226,597 to Eastman *et al.* (hereinafter "Eastman"). Claims 11, 37, and 39 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of U.S. Patent No. 4,985,857 to Bajpai *et al.* (hereinafter "Bajpai"). Claim 16 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of Gollomp and further in view of Bajpai. Finally, claims 18-20, 38-40, and 60-62 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of "A Reliability-Based Model to Predict Scatter in Fatigue Crack Nucleation Life," Tyron *et al.* (hereinafter "Tyron"). Note: the Examiner misspells the leading authors name of this article and the full citation for this article is: Tryon, RG & Cruse, TA (1998) "A Reliability-Based Model To Predict Scatter In Fatigue Crack Nucleation Life." *Fatigue and Fracture of Engineering Materials and Structures*, 21 (3), 257-267.

Claims 1, 5-9, 11, 14-16, 18-23, 25, 28-29, 31-32, 34-35, 37-43, 45, 48, 52, 56-57, and 59-67 have been amended to more clearly define the claimed invention. Furthermore, new claims 68-76 are presented for consideration. Applicants retain claim 2-4, 10, 12-13, 17, 24, 26-27, 30, 33, 36, 44, 46-47, 49-51, 53-55, and 58 in their original form and respectfully present arguments for their allowability. In light of the amendments to the claims and the arguments presented below, Applicants respectfully request reconsideration of the Examiner's rejections.

Claim Rejection - 35 U.S.C. § 102(e)

The Examiner rejects all of the claims under 35 U.S.C. § 102(e) as anticipated by Quist. It is well established law that for a prior art reference to anticipate a claim, each and every element of the claim must be identically shown in a single reference. *See In re Bond*, 910 F.2d 831 (Fed. Cir. 1990).

Quist discloses a “computer... running a global neural network program that receives as its inputs the information from the local monitoring devices 12 and... outputs information representative of the operating characteristics of the various machines.” *See* Quist, col. 4, lines 31-36. These “inputs and outputs may be used to derive the parameters used by the local monitoring devices 12 to establish the local models used by the local monitoring devices 12 for diagnostic purposes.” *Id.* at col. 4, lines 36-40. As disclosed in Quist, the neural network “receives information from the local monitoring devices 12 via the protocol translators 13 and uses that information to develop an updatable statistical model.” (Emphasis Added) *Id.* at col. 4, lines 41-48. It will also be appreciated by one skilled in the art that a neural network, such as the neural network disclosed and described in Quist, is a logic or hard wired approach to predicting failure. Furthermore, one of ordinary skill in the art will appreciate that a logic or hard wired approach is built around and based on test or historical failure data, such as statistical failure data. It will also be appreciated by one of ordinary skill in the art that a system built around and based on test or failure data can only detect or predict failure from failures that have previously occurred and are represented by the historical test or failure data. Therefore, a system such as that disclosed in Quist is limited to predicting failure only based on failures that have previously occurred and are represented by the historical test or failure data upon which the system is based.

In contrast, all the independent claims of the present application, claims 1, 25,

48, 68, and 74 define a *physics based* probabilistic model for predicting failure of a system. Completely unlike Quist, the *physics based* probabilistic model used in the present application is a model that is based on the underlying physics of the system. See Present Application, paragraph [0028]. More particularly, the *physics based* probabilistic models of the present application are based on formulas of mechanics of materials, thermodynamics, and the like, which rely on the failure physics of a component or system. *Id.* As a result, the *physics based* probabilistic models of the present application are developed from and consider fundamentally different theories, data, and mathematics than the analysis system disclosed in Quist.

The *physics based* probabilistic models of the present application have major differences over the neural network methods described by Quist. One advantage of the *physic based* probabilistic approach is that it takes into account the actual physical events occurring within the system during use, and therefore, the model is able to predict a probability of failure even if the failure has not occurred before, i.e., in the historical failure data. Accordingly, Quist cannot disclose the *physics based* probabilistic model disclosed and claimed in the present application. In light of the above, the Applicant respectfully requests the Examiner withdraw this rejection.

Furthermore, claims 8-9, 14-15, 18, 21, 34-35, 38, 41, 45, 52, 56, 57, 60, 63, and 69 require a *physics based* probabilistic model as discussed above. Therefore, all these claims contain allowable subject matter for at least the reasons detailed above. More particularly, claim 15 further recites a grouping of component characteristics such as material properties, environmental conditions, design characteristics, component loading and component usage that are used to identify a failure mechanism for that component. Nowhere in Quist are a components' characteristics, such as, material properties and the like utilized in the step of identifying a failure mechanism of that component. Furthermore, Quist does not formulate a physics based probabilistic analysis, as detailed above. Therefore, it is respectfully requested that the Examiner withdraw the rejection of this claim.

Moreover, Quist discloses sensing quantities such as temperature, vibration, and flux of a system. See Quist, col. 3: lines 27-33. These types of sensings are all directly sensed, i.e., *direct* variable sensing, where a sensor directly measures a quantity or quality and reports or records that quantity or quality. Quist discloses sensing a variability of at least one of these *direct* variables such as the ambient temperature in the area of the sensing element. See Quist, col. 9: lines 31-36. However, unlike the present application, Quist fails

to disclose or suggest any calculation, consideration, or determination of *referred* and/or *inferred* variables of the system as required by claims 11, 16, 37, 59, 73, and 75. The physics based probabilistic model of the present application utilizes *direct*, *referred*, and *inferred* variables of the system to predict the probability of failure. Directly sensed variables are those variables “that change during operation or product use, such as the ambient temperature discussed above;” referred variables are those “that do not (significantly) change during operation or product use;” and inferred variables are those “that change during operation or use but are not directly sensed.” *See* Present Application, paragraph [0016]. The physics based probabilistic model claimed in the present application takes into account variability among all three of these types of variables in modeling the system and predicting failure. *See* Present Application. Quist simply fails to teach this. Accordingly, the Applicants respectfully request the rejection be withdrawn and the claims allowed.

35 U.S.C. § 103

The Examiner also rejected claim 9, 15, 24, 35, 45, 47, 52, 54, and 57 under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of U.S. Patent No. 4,766,595 to Gollomp (hereinafter “Gollomp”).

To establish a *prima facie* case of obviousness, three basic criteria must be met, namely:

- 1) There must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings;
- 2) There must be a reasonable expectation of success; and
- 3) The prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not based on applicant’s disclosure. *See In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

For at least the reasons described above, Quist fails to disclose a *physics based* probabilistic model. Furthermore, Gollomp also does not teach, suggest, or disclose a *physics based* probabilistic model. Accordingly, neither of the references disclose all of the claimed

limitations. For this reason alone, the combination of Quist and Gollomp cannot render these claims unpatentable.

The limitations of the claims of the present application. The Examiner relies on Gollomp to disclose “ranking variables in said probabilistic model according to said variable’s contribution to said prediction.” *See* Office Action, mailed October 6, 2003, pg. 7. Gollomp, however, fails to teach, disclose, or suggest a failure model which takes into account real world variability by measuring and/or calculating *referred* and *inferred* variables as previously described above. Accordingly, the combination of Quist and Gollomp cannot render the claims of the present application obvious.

The Examiner rejected claims 10, 21-23, 36, 41-43, 46, 53, 58, and 63-65 under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of U.S. Patent No. 6,226,597 to Eastman *et al.* (hereinafter “Eastman”). The Applicants firmly disagree with this contention. The disclosure of Eastman teaches away from the invention disclosed and claimed in the present application. Eastman, like Quist, discloses a failure modeling system based on statistical data and not the physics that causes the failures. In fact, Eastman specifically denounces the technique of modeling the physics by disclosing a system “using complex or simple combinatorial statistics... *rather than trying to model the physical failure mechanisms...*” (Emphasis Added). *See* Eastman, col. 6: lines 33-40. Therefore, Eastman, like Quist, does not model failure based on *physics based* probabilistic models as disclosed and claimed in the present application. Furthermore, Eastman fails to disclose, teach, or suggest utilizing *referred* and *inferred* variables in predicting failure of the system. Therefore, for the reasons stated above, the combination of Quist and Eastman cannot render the claimed invention unpatentable, as these references do not disclose all of the rejected claims’ limitations. In light of the above, the Applicants respectfully request the Examiner withdraw this rejection.

Claims 11, 37, and 39 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of U.S. Patent No. 4,985,857 to Bajpai (hereinafter “Bajpai”). Bajpai discloses a Knowledge Base (KB) that “constitutes... a rule base comprising the rules of vibration analysis....” *See* Bajpai, col. 2: lines 17-20. Again, as distinguished above with respect to Quist, a rule based modeling system is dramatically different from the *physics based* modeling system claimed in the present application. Therefore, for at least these reasons and in light of the above, the combination of Quist and Bajpai cannot render these claims unpatentable, as not all of the claim limitations are taught

by these references. In light of the above, the Applicants respectfully request the Examiner withdraw this rejection.

Claim 16 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of Gollomp and further in view of Bajpai. *See* Office Action, mailed October 6, 2003, pg. 13. For at least the reasons stated above, none of Quist, Gollomp, or Bajpai disclose a *physics based* probabilistic modeling approach to predicting a failure of a system as claimed in at least all of the independent claims of the present application. Therefore, in light of the above, the combination of Quist, Gollomp, and Bajpai cannot render the present application obvious. Therefore, the Applicants respectfully request the rejection of this claim be withdrawn and this claim be allowed.

Finally, the Examiner rejected claims 18-20, 38-40, and 60-62 under 35 U.S.C. § 103(a) as being unpatentable over Quist in view of Tryon *et al.* "A Reliability-Based Model to Predict Scatter in Fatigue Crack Nucleation Life," (hereinafter "Tryon"). In light of the above arguments and remarks, the prior art cited by the Examiner is deficient in teaching, suggesting, or disclosing all the limitation of the claims in the present application. Therefore, the Applicants respectfully request the rejection of these claims be withdrawn and the claims allowed.

New claims 68-76 affirmatively claim a *physics based* probabilistic model, as disclosed throughout the specification and described above and, therefore, are also patentable over the cited prior art. No new matter is presented with the entry of the new claims.

In conclusion, the Applicants respectfully request the rejection of the claims be withdrawn and the claims allowed. Accordingly, Applicant respectfully requests that the Examiner reconsider this application with a view towards allowance. The Examiner is encouraged to call the undersigned attorney at (650) 493-4935, if a telephone call could help resolve any remaining items.

Respectfully submitted,

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